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ANALYSIS OF WASTE ON THE PRODUCTION FLOOR WITH LEAN MANUFACTURING METHOD

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ABSTRACT

In defending his company's existence, many ways in which an enterprise so that the results of his efforts remains in demand by consumers. The desire of consumers or the so-called voice of customer is very complex; making the company should give priority to customers above anything else. it aims to keep consumers loyal to the products it makes. PT. Dianjaya Gunawan Steel (GDS) is one of the major companies producing steel plate in Indonesia which has the International level. The company is constantly improving product quality and constantly striving to meet customer desires. But in the process of production of steel plate ABS type-A (12x1524x6096) mm there are still obstacles faced. factor constraints faced by the company so much that it makes less maximum production runs. For example, the waste found on the production floor, resulting in losses to the company.

In this study, researchers tried to analyze the activities that are categorized as non-value added. Therefore we need a method to identify the overall waste by using Lean Manufacturing through a VSM (Value Stream Mapping) Tool, where the selection of his own tools using VALSAT (Value Stream Analysis Tools) in hopes of reducing the waste that occurs. Based on the survey results revealed that of making BPM (Big Picture Mapping), types of waste are successfully identified with BPM is Waiting, Unnecessary Inventory, and Overproduction. Also used are also RCA (Root Cause Analysis) to identify the waste, other waste. To minimize the waste that has been identified is given some of the proposed improvements, such as changing the company policy in preparation *a cutting slab*, can reduce the waiting in the preparation area of *cutting slab* from 10,080 minutes (7 days) to 420 minutes (0.29 days). change company policy in the process of *a cutting slab*, can reduce the waiting area of *a cutting slab* of 4752 minutes (3.3 days) to 272 minutes (0.19 days) and suppress the overproduction of 594 pieces to 34 pieces of slab, while also reducing unnecessary inventory of 17.5 days to 1.9 days. And having analyzed the results of the proposed improvements can significantly reduce production lead time is initially 14 952 minutes (10.39 days) to 812 minutes (0.56 days).

Key Words : *Lean manufacture, Waste, BPM, Value Stream Mapping, VALSAT, Process Activity Mapping*

Introduction

In defending his company's existence, many ways in which an enterprise so that the results of his efforts remains in demand by consumers. The desire of consumers or the so-called voice of customer is very complex to make the company must give priority to customers above anything else. it aims to keep consumers loyal to the products it makes.

PT. Gunawan Dianjaya Steel Tbk. (GDS) is one company that focuses on customer satisfaction. The company is constantly improving product quality and constantly striving to meet customer desires. The resulting product is a steel plate GDS. Production is done is job order. The Company will make production according to customer demand. Slab is a type of raw material used to make steel plates. To maintain consistency of product quality, the company evaluated every 3 months. In the production process there are still some problems faced by the company include the results of a defective product, the existence of material waiting to be processed, the material displacement of the old, still the workers not wearing safety equipment so as to increase the number of workplace accidents. In the process of cutting plates, measurements were repeatedly given the plate temperature is still hot, so workers are not too confident with the results of measurements that makes the measurements were made several times. In working hours there is still rolling system if there are workers who do not enter. The existence of an additional process of rework to get the appropriate results. This additional process is the process of grinding if found to the side of the plate is not flat. On the production data for the year 2010 known types

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of steel plate is the most ordered plate steel with ABS-A specification (12x1524x6096) mm. Therefore, the ABS-type products were subjected to a priority for observations in this study.

Based on the problems faced by PT.Gunawan Dianjaya Steel Tbk. then this study using methods of Lean Manufacture is done by understanding the general picture of the company through the flow of information and material contained on the production floor in PT.Gunawan Dianjaya Steel Tbk. which include activities that have value-added activity, which has no added value, and activities that do not add value but it is necessary to produce the product, so that by knowing the general picture is a problem can be known and sought a solution by providing recommendations for improvement, so the purpose of producing products in accordance with the desires of consumers (customer needs) will be achieved.

Research Method

The data was collected on the production in January 2011 to the achievement of the required amount of data. The data was collected in various ways, namely :

a. ***Interview***
Interview conducted directly to the source is someone who knows the production process as in the production, the PPIC, and QC. Data collected includes physical data flow, data flow information and also data on nine types of waste.

b. **Documentation**
Data or information collected by the method of documentation of the existing archives in the company include the results of the product and its specifications, production quantities, and the layout of the production floor.

c. **Questionnaire**
The collection of data obtained by giving questionnaires to several people who know the whole production process on the production floor. The questionnaire contains about nine weighting waste.

d. ***Observation***
Observations directly to the object under study so that it can be seen clearly the course of the production process that aims to solve problems in research.

The data already collected will be processed using methods that have been studied by researchers from the study of literature, such as lean manufacturing, VALSAT. These methods will be used to solve problems that are at the production company.
The data processing includes:

1. Weighting the data processing waste
2. Making current state value stream mapping.
3. To identify waste that occurs in the production area with VALSAT
4. Identify causes of waste.
5. Making some of the proposed improvements to minimize the wastage that occurs.

From the results of weighting the nine waste is known that the highest value is the waste that often occurs in the production area.

- Questionnaire form the basis of identification with the selection tools that are relevant to VALSAT.

Point obtained from the questionnaires will be multiplied by the value of the correlation between the tools with the waste that occurs in order to obtain scores for each of the tools that exist in VALSAT. Selection of tools based on the largest score obtained, which will generally be selected with the highest score of two tools that will do data processing. From the results of calculations have been performed, then the ranking is based on the highest to the lowest score will be performed. The highest score will be ranked first and so on up to rank ninth. From the ranking, obtained the order of the most relevant tools to use.

Production Time Data When the production process of steel plate ABS type-A (12x1524x6096) mm in PT.Gunawan Dianjaya Steel, Limited will be described in the table below.

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Table 1. Production Process time ABS-type steel plate A (12x1524x6096) mm in PT.Gunawan Dianjaya Steel, Tbk. Surabaya (per sheet)

No.	Process	Time (minutes)
1	*Cutting slab* Process	12 minutes
2	*Reheating furnace* Process	8 minutes
3	*Descaler* Process	1 minutes
4	*Rolling Mill* Process	8 minutes
5	*Hot leveler* Process	8 minutes
6	*Dividing shear* Process	4 minutes
7	*Cooling bed* Process	60 minutes
8	*Cropping & side shear* Process	10 minutes
9	*Marking* Process	3 minutes
Total		**114 minutes**

Formulation and Filling Questionnaire

In the production process of ABS-A steel plate there is waste that can be minimized or even eliminated. To identify waste that occurred created a questionnaire that contains nine concept of waste / waste nine given to people who know the whole production process include the PPIC, the production, and the QC. This questionnaire was distributed containing as many as 6 people on the explanation of each type of waste (in the concept of nine waste) which will then be weighted according to conditions prevailing production floor. Questionnaires distributed contains several questions related to the concept of waste to be identified nine. List of the questions are formulated with the aim to determine the weight of waste that is by considering the intensity factor of the occurrence of such waste. Choice answers have been included in the questionnaire in order to standardize and facilitate the answers of respondents to provide answers in accordance with the conditions on the production floor.

Choice of answers prepared by the ranking system, where for the highest weight is 5 (1 hour), then 4 (1 shift once), 3 (1 day), 2 (1 weeks), 1 (6 months), and 0 (completely unheard of).

Reliability Test

For the reliability test carried out by calculating the alpha value with the help of SPSS software 16. If the value of alpha obtained from the calculation> alpha table then said to be reliable data which means data from the measurement results with the questionnaire can be trusted.

From the calculation of reliability of test results obtained as follows:

Table 2. Reliability Test Results

Waste Data Questionnare	r_{count} (r_{alpha})	r_{table}
	0,851	0,729

From the results above shows that the alpha value (0.851) is greater than the value of r table (0.729) so that it can be said that the data obtained are reliable. Reliability test results of weighting the value of waste can be seen in appendix E.

Data processing

Weighting Waste

Once the data is said to be reliable questionnaire results then the next step is to calculate the weight of each type of waste. From the results of questionnaire distribution, it is known that the weight of waste that occurs from largest to smallest is as shown in Table 3. as follows:

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Table 3. Waste Workshop results

NO	*WASTE*	RESPONDENTS						WEIGHT	RANK
		1	2	3	4	5	6		
1	Produksi berlebih	5	5	5	4	4	5	4,7	1
2	Menunggu	4	4	3	4	4	4	3,8	2
3	Transportasi	4	4	3	4	3	4	3,7	3
4	Proses tidak sesuai	3	4	3	3	3	4	3,3	4
5	Persediaan tidak perlu	2	3	2	2	3	2	2,3	5
6	Gerakan tidak perlu	2	3	2	2	2	2	2,2	6
7	Kecacatan	1	2	1	1	1	2	1,3	7
8	Pekerja tidak mempunyai skill	0	2	1	0	1	1	0,8	8
9	Lingkungan kesehatan dan K3	0	1	0	0	0	0	0,2	9

(sources of information: the results of data processing in Appendix D)

Example on how to weighting a waste point :

$$Waiting = \frac{\text{Total score of } waiting \text{ waste point}}{\text{Total respondents}}$$

$$= \frac{5+5+5+4+4+5}{6} = 4{,}7$$

From the results of a questionnaire that was distributed computation, obtained types of waste which has an average score of the greatest to the smallest sequence that is waiting (4.7), unnecessary inventories (3.8), defect (3.7), overproduction (3.3), transport (2.3), a process that does not fit (2.2), unnecessary motion (1.3), environmental health and safety (0.8), as well as workers who lack professional (0.2).

Identification of Factors Contributing to Waste With RCA (Root Cause Analysis)

In this section the problem will be identified more specifically about the waste that occurs on the production floor based on questionnaires and interviews that have been propagated to the coordinator on the production, PPIC, and QC. They also analyzed the factors that give rise to the cause of these problems, facilitating the improvement of production systems in the manufacture of steel plate PT.Gunawan Dianjaya Steel, Tbk. Waste (waste), among others are described as follows:

Waiting

This type of waste often occurs during the production process where the greater the waiting time that occurs it will extend lead times and increase work in process.

Problems:

- The occurrence of material buildup in the preparation area and the area of the slab cutting
- The machine jammed / breakdown during the production process takes
- Cessation of production activities due to the replacement of equipment on the production machine

The root cause of the problem:

- The company policy is less effective in the preparation process of cutting the slab
- Installation of equipment not in accordance with the procedures that should
- The operator failed to SOP

Results and Discussion

From the identification of waste by using a questionnaire on acquired types of waste that occurs in the order from most common to rare cases of waiting, unnecessary inventory, defects, overproduction, transportation, process inap-propriate, unnecessary movements, envi-ronmental health and safety, and workers who are less professional.

In the steel plate production process involving 23 events, where there are only nine of value-added activities (value adding activitty) or appro-ximately 39.13% while the time needed to con-duct a value-added activities (value adding acti-vity) is 114 minutes or about 0, 73%. For Neces-sary but non-value added amounting to 14 435 minutes atu approximately 92.74% and non-value added for 1015 minutes, or by 6.52%. Here can be seen a lot of waste that occurs. While the amount of labor in the production process of steel plate in one of her shift as many as 27 people.

The results of the identification of the root causes of waste - waste that occurs on the production floor along with the proposed enhancements are:

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a. Wait
This wastage occurs because of company policy that is less effective in the preparation process of cutting the slab so that the resulting accumulation of slab waiting to be processed and also because of the production machine jammed. The proposed fix is to change company policies in the preparation process of cutting the slab so as to suppress waiting from 7 days to 1 shift (0.29) days. It also provides training on the maintenance worker.

b. Unnecessary inventory
This wastage occurs because of company policy that is less effective in the preparation process of cutting the slab resulting in the unnecessary inventories in preparation for cutting the slab area. The proposed fix is to change company policies in preparation for cutting the slab

c. Disability
This wastage occurs because there is no temperature gauge plate and also from human factors such as different operator skills and operator boredom level. The proposed fix is to manufacture plate temperature measuring device and also provides training to operators to improve the work

d. Overproduction
This wastage occurs because of company policy is less effective in the process of cutting the slab. The proposed fix is to change the company's policy in the process of cutting the slab.

e. Transportation
This wastage occurs because the distance is too far between the slab cutting with the next work station and also machine tools are less supportive. The proposed fix is to reform the production floor layout and boosted the number of cranes for the transport

f. The process does not need
This wastage occurs because of the many errors of human factors / operator. The proposed fix is to conduct training in labor / operator.

g. The movement does not need
This wastage occurs because of lack of facilities and equipment ergonomic workplace. The proposed fix is to make corrections facilities and work equipment

h. Environmental Safety and Health
This wastage occurs because of lack of supervision to the work force, so that labor does not comply with the K3 and still less conscious workers to wear safety equipment. The proposed improvement is enhanced supervision and make notification to the workforce about the importance of K3

i. Workers who are not expert
This wastage occurs because of employee absenteeism and workers bored with his job. The proposed improvement is to provide a more overtime pay for employees and provide training to the workforce

After the proposed improvement of the above is done then the production of waste that occurs on the floor can be minimized, particularly for waste types waiting, unnecessary inventory, and overproduction by the results of value stream improvement as follows:

1. Reduction in the waiting area of the preparation of the cutting slab 10 080 minutes (7 days) to 420 minutes (0.29 days).
2. Reduction of lead time in the area of cutting the slab of 4752 minutes (3.3 days) to 272 minutes (0.19 days).
3. Reduction of overproduction in the area of cutting the slab of 594 pieces to 34 pieces of slab slab which causes unnecessary inventory.
4. Reductions of production lead time of 14 952 minutes to 812 minutes.

From the results of these improvements can be shown to the big picture mapping (future state map)

Conclusion

The conclusions can be drawn from this study are as follows:

1. The results of the identification of types of waste in the production of steel plate with a big picture mapping can be seen that type of waste which significantly influence the flow of steel plate production system in PT.Gunawan Dianjaya Steel Tbk. Surabaya include:
   - Waiting (Waiting)
   - Inventories are unnecessary (Unneces-sary Inventory)
   - Excess production (Overproduction)
2. Based on the results obtained by the proposed identification and analysis of the value stream improvement of production systems as follows:
   - Changing the company's policy in preparation for cutting a slab, can reduce the waiting in the preparation area of the slab cutting 10,080 minutes (7 days) to 420 minutes (0.29 days).
   - Changing the company's policy in the process of cutting a slab, can reduce lead time in the area of cutting the slab of 4752

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minutes (3.3 days) to 272 minutes (0.19 days) and can also reduce the overproduction in the area of cutting the slab of 594 pieces of slab to 34 pieces of slab which causes unnecessary inventory of 560 pieces of slab.

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